into one general dictionary, and the omission of the former part dealing with morphology, classification, geographical distribution, economic uses, etc. There are approximately 20,000 entries, so that a wealth of information is available at a minimum of trouble.—J. M. C.

NOTES FOR STUDENTS

Tropical rain forests.—Two recent contributions have added considerably to our knowledge of the ecology of tropical rain forests, especially as both present quantitative data concerning habitat and also the vegetation. The first by BROWN[6] deals with the vegetation of a portion of the Philippine Islands, and the second by MCLEAN[7] with some of the rain forest near Rio de Janeiro, Brazil, and is the continuation of a report already noticed.[8] This rain forest of Brazil is regarded as the climax type for a large portion of the country. A biological spectrum of the Raunkiaer type would show an enormous preponderance of woody plants arranged in three distinct strata, the ground flora being comparatively open. There is a great diversity of species, with the Leguminosae as the most prominent family, and the Rubiaceae and Piperaceae important among the undershrubs. Ferns and lycopods are largely limited to rocky spots. Conspicuous flowers are abundant in the upper canopy and notably lacking below. Buttressed tree trunks are rare, in spite of the frequency of violent winds, but thorny stems are frequent even in large trees. The floristic diversity and the contrasting uniformity of appearance, especially in leaf form, are ascribed to (1) the antiquity of prevailing conditions, and (2) the peculiarity of the environment. The soil is shallow and pervious, with a water-holding capacity of about 40 per cent, and an average water content of 10 per cent. It is deficient in mineral nutrient material and particularly in calcium carbonate. The humus content is about 3 per cent. *Mycorhiza* are very abundant. A very considerable amount of rain is intercepted by foliage and evaporated into the air, thus reducing the rainfall efficiency. Light measurements made with photographic exposure meters show the average ratio of the light outside and that within the deep forest to be 1:0.06; some spectroscopic measurements, however, tend to show that the photosynthetic efficiency of the shade illumination is relatively greater than the actinic.

The leaves of the forest are in general characterized by their larger size, the small number per plant, and the frequency of nyctitropic movements and of the vertical position. The shade leaves show conspicuous water-storing epidermis, reduced and undifferentiated mesophyll, and occasional epidermal papillae. The leaf area of the sun foliage is approximately the same as that of the shade leaves, but the latter are decidedly larger and narrower. Red coloration is common in the young shade leaves, and such leaves are shown to have a higher rate of respiration. The percentage of carbon dioxide within the forest is shown to be high, and here light is doubtless the limiting factor of photosynthesis.

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[6] BROWN, W. H., Vegetation of the Philippine Mountains. Dept. Agric. and Nat. Resources, Bur. Sci. Pub. **13**:434. *pls. 41. figs. 30.* Manila. 1919.

[7] MCLEAN, R. C., Studies in the ecology of tropical rain forest; with special reference to the forests of South Brazil. Jour. Ecol. **7**:121–172. *figs. 10.* 1919.

[8] BOT. GAZ. **69**:92–94. 1920.

BROWN agrees with McLEAN in recognizing valley and mountain forest types, and in addition describes a distinct transition form. The lowland type of the part of the Philippines under consideration is the Dipterocarp forest and extends to an altitude of 600 m. It exhibits distinct strata or stories composed of vegetation 40, 20, and 10 m. high respectively. Epiphytes are largely phanerogams, and are confined chiefly to the largest branches of the tallest trees. Buttressed trees and cauliflora are developed by many species, while the ground covering is characterized by rattans in the rosette stage. On a typical plot there were 22 first story species, 43 second story species, and 23 lower story species.

The midmountain forest extends from 600 m. to an elevation of about 900 m. and shows two stories of about 18 and 8 m. in height. One typical association is termed the *Quercus-Niolitsea* forest from the most abundant genera. The undergrowth is less dense, but the ground cover of ferns and herbaceous plants is better developed than in the Dipterocarp forest. Epiphytes are also more abundant, and include more cryptogams. Above 900 m. a montane forest is developed, exhibiting a single stratum of vegetation some 10 m. high, and known as the "mossy forest" from the great abundance of mosslike plants.

As developed on Mt. Maquiling this last may be termed a *Cyathea-Astronia* association from the two most prominent genera. The herbaceous ground cover is dense; mosses, filmy and other ferns, *Selaginella,* orchids, and lianas are abundant, many growing as epiphytes. Trees are low and contorted in habit. Statistical analyses are made of all types of forest, the size of the trees as well as their floristic relationship being given. Detailed data regarding rates of growth of trees seem to show that they are proportional to the heights of the various forest types. Stations were located in these forests, and at them measurements were made of environmental factors, including temperature, light, evaporation, rainfall, humidity, soil moisture, and wind velocity. Many data were collected and are presented in tables and graphs. Some of the most interesting conclusions based upon these are: (1) humidity is high at all elevations, and the atmosphere is practically saturated at all times under the montane forest; (2) temperature gradually decreases with rising elevation; (3) evaporation in all forests is much less than in the mesophytic forests of the United States, and decreases rapidly with increasing altitude; (4) there is a pronounced, although not severe, dry season; (5) only at low elevations does there appear to be sufficient decrease in soil moisture during the dry season to have any harmful effect on vegetation; and (6) the increase in herbaceous vegetation with increasing altitude is due to increased soil moisture and decreased rate of evaporation.

An analysis of the foliage shows that leaves with entire margins are more abundant in the lower stories than in the upper, and at lower elevations than at higher ones. Classified according to the system devised by RAUNKIAER, the plants over a meter in height are found to show but three leaf sizes, and the number of species with microphyll, mesophyll, and macrophyll leaves are, for the most part, Dipterocarp forest, respectively 4: 79: 9; for the mid-mountain forest 4:61: 5; and for the mossy forest 8:8:0, showing a decided decrease in leaf size with increase in elevation.

The Philippine vegetation is made more attractive to the reader by numerous good photographs reproduced on excellent plates.—GEO. D. FULLER.

Transpiration studies.—A series of papers by SAYRE[9] contains some interesting results regarding transpiration from hairy leaves. The leaves of the mullein, *Verbascum Thapsus*, offer more resistance to water loss in darkness than in light, in still air than in wind, and respond rather more to changes in environment than do the smooth leaves of tobacco, *Nicotiana* sp. The removal of the hairs of the mullein leaves resulted in no change of resistance in still air and light, and but slightly reduces resistance in wind and light. There was a greater reduction of resistance to water loss caused by the removal of hairs in still air and darkness, as under such conditions transpiration is entirely cuticular. Hence it appears that, in this plant at least, hairs as a covering affording protection against ordinary intensities of wind and light are quite inefficient and may be disregarded. The stomatal water loss is 20–40 times the cuticular, and only the latter is influenced by the removal of the hairs.

Transpiration, humidity, evaporation, and sunshine were recorded along with the water loss from sealed potted plants. Stomatal transpiration is shown to be governed by various factors which control the opening and closing of the stomatal pores, and by the diffusion gradient. An increasing saturation deficit of the intercellular spaces of the mesophyll is regarded as important in increasing the resistance of the leaf to water loss while stomata are open, but as of no effect after stomata are closed by darkness.

The tobacco and *Verbascum Thapsus* show a rhythm in the transpiration curve in darkness for one day only succeeding a day of normal light exposure, but *V. Blattaria* exhibits no such rhythm under the same conditions.—GEO. D. FULLER.

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[9] SAYRE, J. D., Comparative transpiration of tobacco and mullein. Ohio Jour. Sci. **19**:422–426. *fig. 1.* 1919.

———, Factors controlling variations in the rate of transpiration. *Loc. cit.* **19**:491–509. *figs. 9.* 1919.

———, The relation of hairy leaf coverings to the resistance of leaves to transpiration. *Loc. cit.* **20**:55–75. *fig. 7.* 1920.